

Recycler Flying Wires

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History

- First installed in January 2003, taken out in a few months.
- Vacuum measurements done in ANL.
- Installed on August 28th, 2004.
- Good vacuum.
- Quickly commissioned after the shutdown.
- Software bugs fixed.

System description

- Horizontal and vertical wires.
- Wire diameter measured: 33 micro-meter.
- Four scintillation counters.
- Two filters (10% and 60%) per scintillation counter to extend dynamic range.
- ACNET page R35.

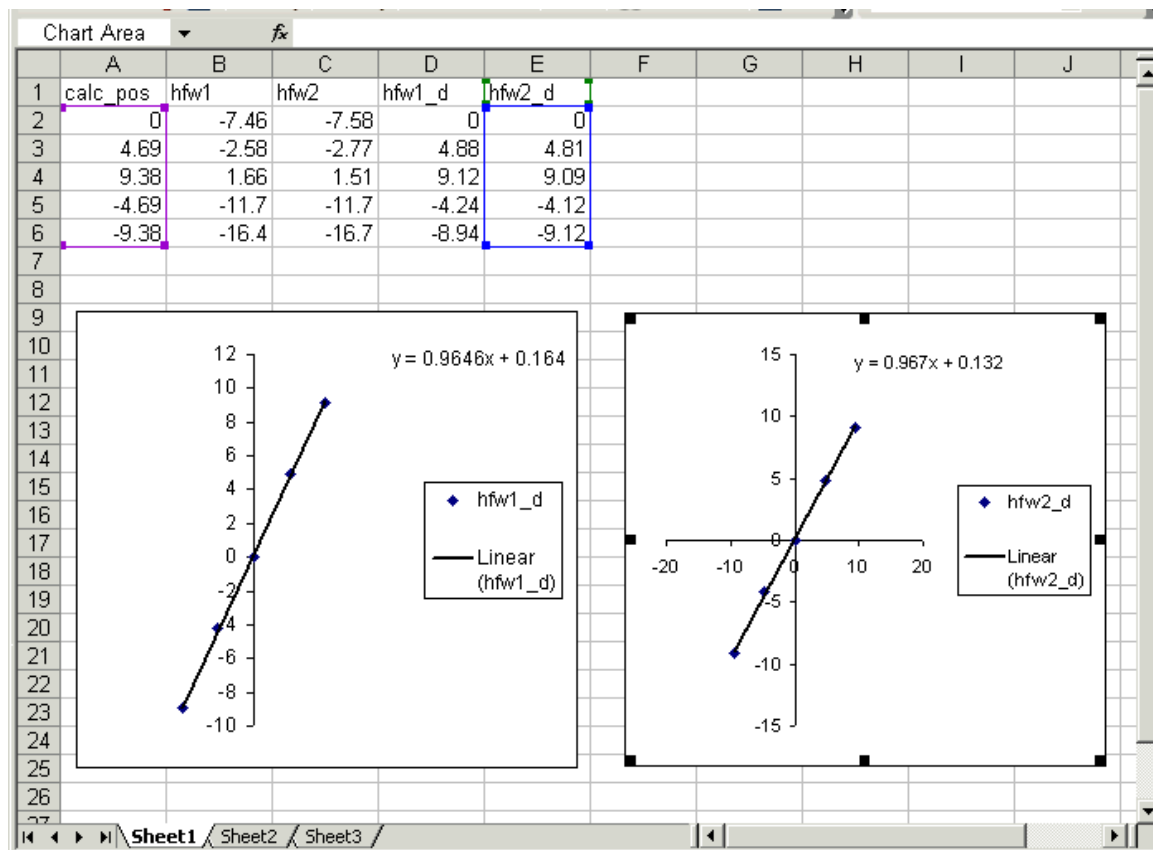
Operations

- Recycler stores $< 1\text{E}10$ to $>1\text{E}12$ particles at present. The FW system has the right dynamic range.
- Computed limit is $150\text{E}10/\text{mm}$ based on wire heating concerns.
- Measured emittance growth is about 0.4 pi-mm-mr per operation (4 wire crossings).
- Very useful when Schottky measurements do not work due to momentum width; limited usefulness from the perspective of emittance preservation.

Calibration

- Schottky detector has been calibrated with mechanical scrapers and beam.
- Schottky detectors measure the RMS size of the beam; FW system makes Gaussian fits to the beam profile.
- For a cooled pbar beam (Gaussian profile) the two systems agree well ($<10\%$).
- It has been shown (Stephen, RR) the disagreement in emittance measurements is dominated by distribution.

Three bump vs. peak displacement



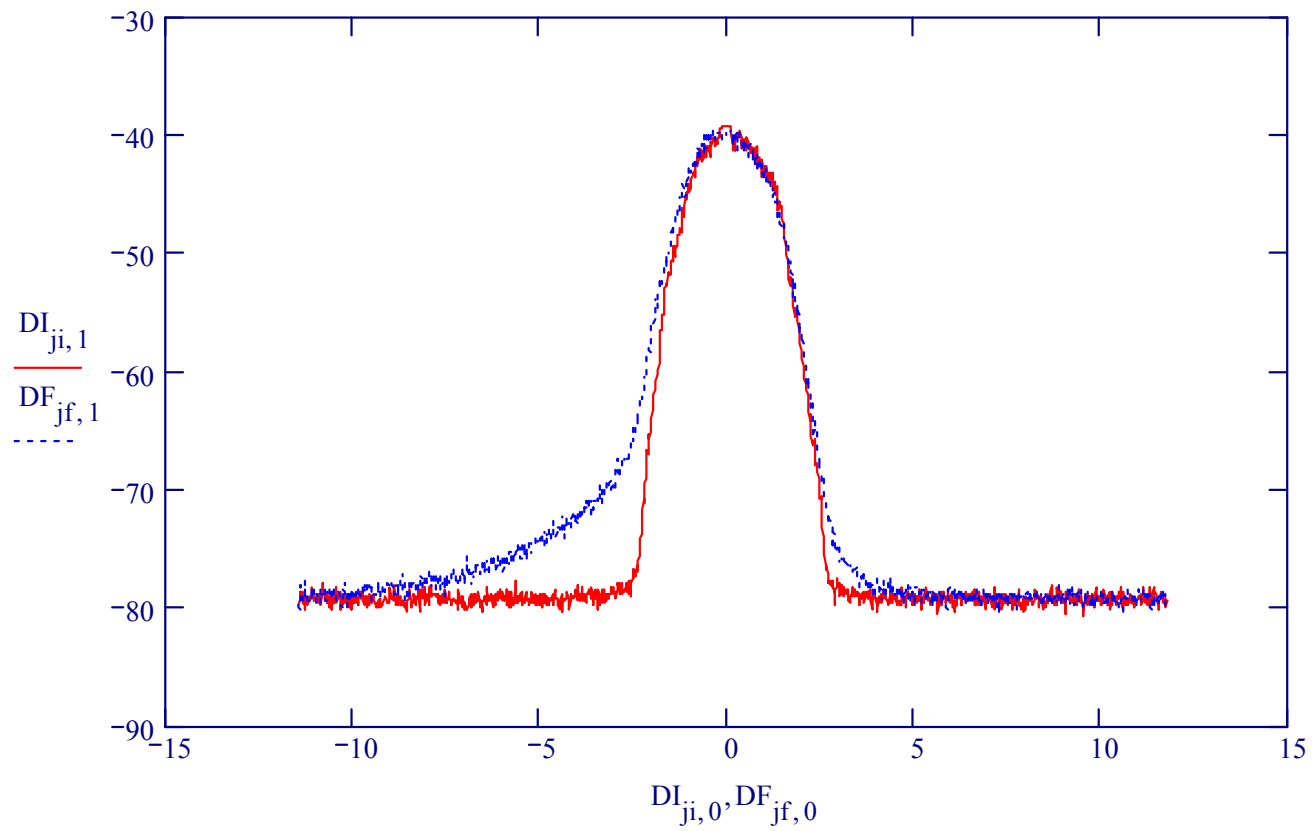
Computing the charge number from the energy loss/emittance growth of wire-beam interaction

$$\Delta\varepsilon(Z) := 6 \cdot \beta \cdot \frac{\beta l}{2 \cdot \gamma} \cdot \left(\frac{13.6}{938} \right)^2 \cdot \frac{Z \cdot (Z + 1) \cdot \ln\left(\frac{287}{Z}\right)}{716.4 \text{ A}} \cdot X_0$$

$$\Delta E(Z) := K \cdot Z^2 \cdot \frac{Z}{A} \cdot \frac{1}{\beta^2} \cdot \left[\frac{1}{2} \cdot \ln \left[\frac{2 \cdot m_e \cdot \beta^2 \cdot \gamma^2 \cdot T_m}{(12 \cdot Z + 7)^2} - \beta^2 \right] \right] \cdot X_0$$

X_0 is the radiation length of the scattering medium.

Ionization energy loss measurement



Questions to be answered

- Energy loss measured agrees with computation based on carbon fiber
- Computed charge number is low ($\sim 50\%$)
- Emittance growth measurements that much off by both detector systems?
- Uncertainty in the material (and density) in the wire used.